THE FLASH FLOOD AT LENNOXVILLE, OCTOBER 14–17, 2005: THE PHYSICAL GEOGRAPHY

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An unusual Autumn

The autumn period of 2005 in Lennoxville, specifically September and October, was characterized by some rather unusual meteorological conditions: maximum, minimum and mean temperatures were unusually high. The September and October 2005 temperatures were all at least 2 degrees Celsius higher than the Normals measured from 1971–2000 by Environment Canada (2005). Precipitation amounts were also above normal for both months. September was slightly above normal, receiving 7 mm more than the recorded average, while October received over twice the expected precipitation. The normal October precipitation is 86.7 mm; October 2005 received 205.8 mm (Environment Canada, 2005).

Much of the October precipitation occurred during a single three-day period in mid-October, the 14th, 15th and 16th, when a total of 102.8 mm of rain fell in Lennoxville. As a result of this unusually large input of rainfall, the local area experienced its first recorded October flood event. Floodplains throughout this part of the Eastern Townships were inundated with water, causing the disruption of road traffic, closing of businesses and schools, and evacuations of buildings. This paper will explore the hydrological and meteorological causes of the rainstorm and the resulting flood event.

The background

Rainstorms in the mid-latitudes are produced by traveling low pressure systems, or cyclones. For southern Quebec the cyclonic systems which bring most of the regional precipitation originate in two general locations: western Canada/United States, and the eastern seaboard of the United States. The former pick up most of their moisture as they move over the Great Lakes, the latter derive mois-

ture from the Atlantic. During a normal situation these systems move through singly, staying over one location for one, or occasionally, two days. On rare occasions two systems arrive together and, on even rarer occasions, they stabilize over a region. This is what occurred in mid-October 2005.

According to Environment Canada, on the weekend of October 15th and 16th two very slow-moving cyclonic systems were the main influences on the regional weather. One system situated over western and central Ontario brought relatively warm, moist air from the Great Lakes into southern Quebec; the second, more intense, low pressure system moved north up the Atlantic coast to become virtually stationary over New Brunswick. The latter system brought most of the rain which fell on the Lennoxville area that weekend, pumping copious amounts of moisture from the Atlantic to southern Quebec.

The combined effect of the two cyclones produced the largest three-day rainfall in recorded meteorological history for Lennoxville; 102.8 mm from Friday to Sunday (Table 1). There have been larger single day events: the 84.3 mm of rain which fell on October 20, 1937 is the largest recorded October event. In fact, the 46.8 mm which fell October 16, 2005 is only the sixth largest single-day rain event in the last 91 years (Figure 1). From the data available in this Figure, there is no clear evidence of an increasing frequency of heavy rainstorms in October in Lennoxville. In fact a simple linear trend analysis shows a slight decrease in storm magnitude from 1915 to 2005. Also, there exists no media record of a flood occurring in the Sherbrooke area in October, dating back as far as 1900 (Jones, 2002). It was the relatively rare combined influence of two slow-moving cyclones which created the three-day rain event and consequent flood conditions of October 2005.

Year	Peak Rainfall	Secondary Rainfall	Tertiary Rainfall	Total 3-Day Rainfall
1919	45.5	14	0.0	59.5
1923	57.2	4.6	0.0	61.8
1932	48.8	4.3	0.0	53.1
1937	84.3	0.5	0.0	84.8
1952	49.3	11.7	0.0	61.0
1954	46.2	12.7	0.0	58.9
1962	65.8	18.0	2.8	86.6
1987	45.2	9.0	0.0	54.2
1995	46.0	7.0	2.5	55.5
2005	46.8	44.8	11.2	102.8

Table 1. Largest 3-Day October Rainfall Events in Lennoxville (1915–2005)

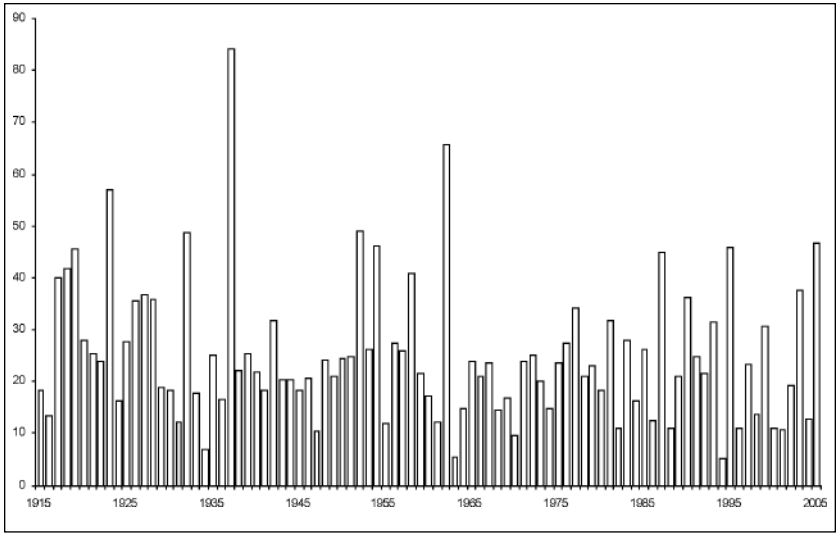

Figure 1. Maximum Daily October Rainfalls in Lennoxville

The results

Lennoxville sits at the outlet of the Massawippi River drainage basin and at the confluence of the Massawippi and St. Francis Rivers. Much of the water passing through Lennoxville, and occasionally producing flood conditions, originates in the Massawippi basin. The physical geographic characteristics of the basin, its geology, geomorphology and hydrology, combine to give the basin a 'flashy' character. It has a short basin lag time, that is, the time between a rainstorm and the peak of river discharge is relatively short. Jones (1998) has estimated that water can move from the top to the bottom of the basin in as little as 24 hours. This 'flashy' behaviour can be seen on a flood hydrograph for a rainstorm event. The October 2005 flood hydrograph is presented in Figure 2. The Massawippi River discharge, in cubic metres of water per second (cms), is low for the beginning of the month, usually well below 50 cms. However, with input of water from rainfall on the 14th and 15th the discharge curve begins a steep ascent; increased rainfall on the 16th pushes the discharge curve to 322 cms on October 17th, almost twenty times the 16.3 cms seen on the 14th.

The decline in water volume after the weekend rainfalls is almost as steep as the ascent. Minor rainfalls on October 17th, 18th and 19th keep the discharge levels higher than those seen during the first half of October, and then six days of rain from the 22nd to the 27th keep the discharge in the 100 cms range, but not high enough to create

flood conditions. The overall high rainfall input of 205.8 mm for the month of October means the river discharge level is much higher at the end of the month relative to the start: 80.6 cms on October 31st, compared to 9.2 cms on October 1st.

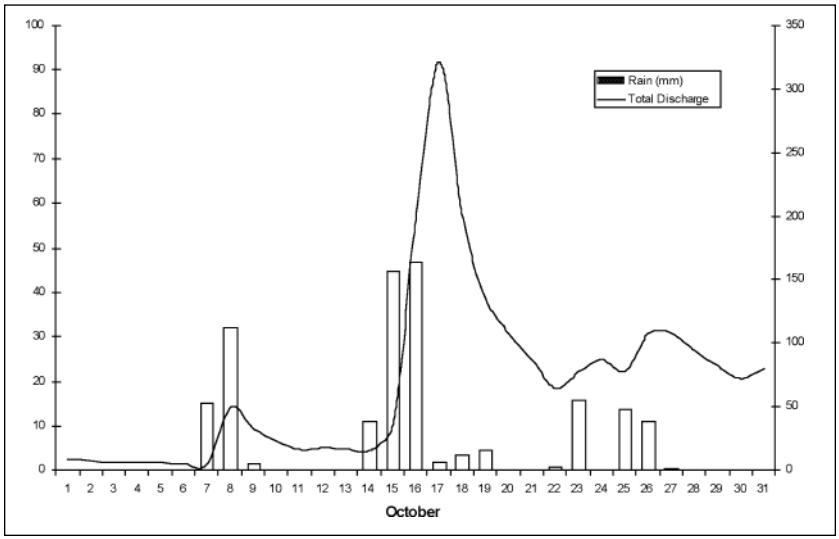

Figure 2. Massawippi River Flood Hydrograph in Lennoxville

Similar river discharge behaviour can be seen for the St. Francis River in Sherbrooke (Figure 3). The flood hydrograph follows essentially the same pattern as the one for the Massawippi River in Lennoxville. The short basin lag time, quick ascent to peak discharge and fairly quick descent of the discharge curve are all evident. The biggest difference between the two curves is, of course, the quantities of water being moved. In the St. Francis River, discharge on October 1st was 73.7 cms; this volume rose to 120 cms on the 14th, peaked at 1525 cms on the 17th, then fell to 323.3 cms on October 31st. Despite the differences in water volume, the steep ascent of the discharge curves relates quite well the suddenness of the rise in levels of both rivers. The flood of mid-October 2005 is thus termed a 'flash flood'.

Most floods in the local region are Spring events caused by a combination of rainfall, snowmelt and ice jams (Jones, 2002). However, flash floods caused by intense rainstorms are infrequent, yet well-known, events in the Lennoxville area. The most infamous was the sudden, large rainstorm responsible for the most disastrous flood in local history: the April 1982 flood. Jones (2004) showed how this event was caused not by an accumulation and quick melt

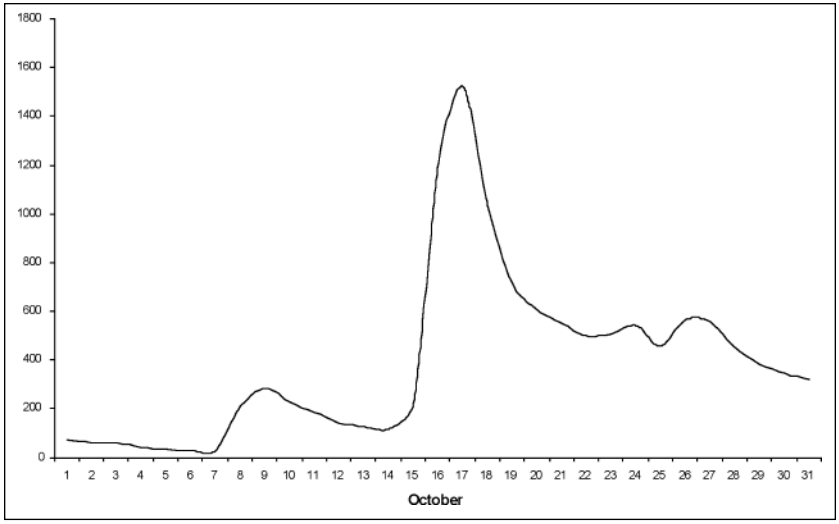

Figure 3. St Francis River Discharge in Sherbrooke

of winter snow or a large ice jam, but by rainfall alone. The flashy nature of the Massawippi River, combined with the suddenness of the rainstorm produced the flood conditions witnessed in that year. The October 2005 event was a smaller version of the 1982 event.

The damage

Source: 1982 Lennoxville Flood, ETC 33-278

Flood events in the Lennoxville area do not tend to be life-threatening. The major consequences of these floods are short-term disruption of transportation, brief displacements of people through evacuations from the floodplain, minor infrastructure damage, and disruption of some local businesses, mainly in the agricultural sector. The important exception to this general statement was the 1982 flood which caused major economic damage (Jones, 2004). The October 2005 flash flood was unusual in its timing, but was a typical Lennoxville flood in its consequences.

Figure 4. Main Entrance to Bishop's University
Source: Christopher Tomson, Bishop's University Undergraduate Student, Environmental Studies and Geography.

Figure 5. Little Forks Street
Source: Christopher Tomson.

Floodplain inundation occurred from just south of town at the Wera and Beaulieu Farms' agricultural fields to the confluence of the Massawippi and St. Francis Rivers at the Bishop's University campus (Figure 4). Little damage occurred at the Farms; some stock had to be moved due to the rising floodplain water. College Street in Lennoxville was the most severely affected transportation route. Streets nearby, especially Little Forks which runs parallel to the St. Francis River just downstream of the confluence with the Massawippi, were almost completely inundated (Figure 5).

The bridge on College Street was closed at about 5:00 p.m. on the afternoon of Sunday, October 16 when local officials deemed the bridge unsafe. Concern was that debris being carried by the surging floodwaters could cause instability in the bridge which was going through major modifications at the time (Figure 6). Of the 150 people evacuated from their homes on Sunday, 125 were Bishop's University students living in the student apartment area just west of the College Street Bridge. The bridge closure meant that many of the Bishop's University students would not be able to get to campus; thus, early Monday morning University officials decided to close the University for the day. The bridge was re-opened for pedestrian traffic Tuesday morning after safety inspections were completed. The University also re-opened Tuesday morning.

Figure 6. Debris at the Upstream Side of the College Street Bridge
Source: Christopher Tomson.

Outside of Lennoxville little damage was caused by the floodwaters. The City of Sherbrooke Public Works compound on Grandes-Fourches Street was temporarily closed when water from the St. Francis River covered approximate 75 cm of the city garage (Sherbrooke Record, 2005). Some vehicles were moved to higher ground. No major damage was reported from Sherbrooke, or surrounding towns and villages.

Summary

The Lennoxville mid-October flood of 2005 will go down in history as the first October flood event of record. The flood was the result of a rare appearance of two quasi-stationary low pressure cyclonic weather systems to the east and west of the region. These systems delivered the largest three-day amount of rain in history, leading to this unique October flood event. The flood caused some minor inconvenience, especially to Bishop's University students, faculty and staff, but little physical damage.

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